Robert Eller Associates, Inc.

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

VALUE AND GROWTH OPPORTUNITIES FOR OLEFINIC-TPEs IN AUTOMOTIVE INTERIORS

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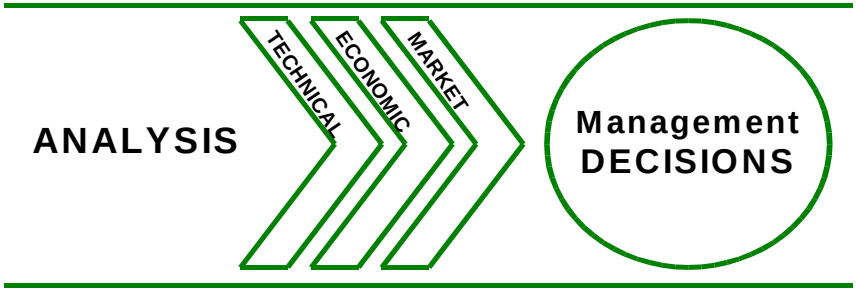
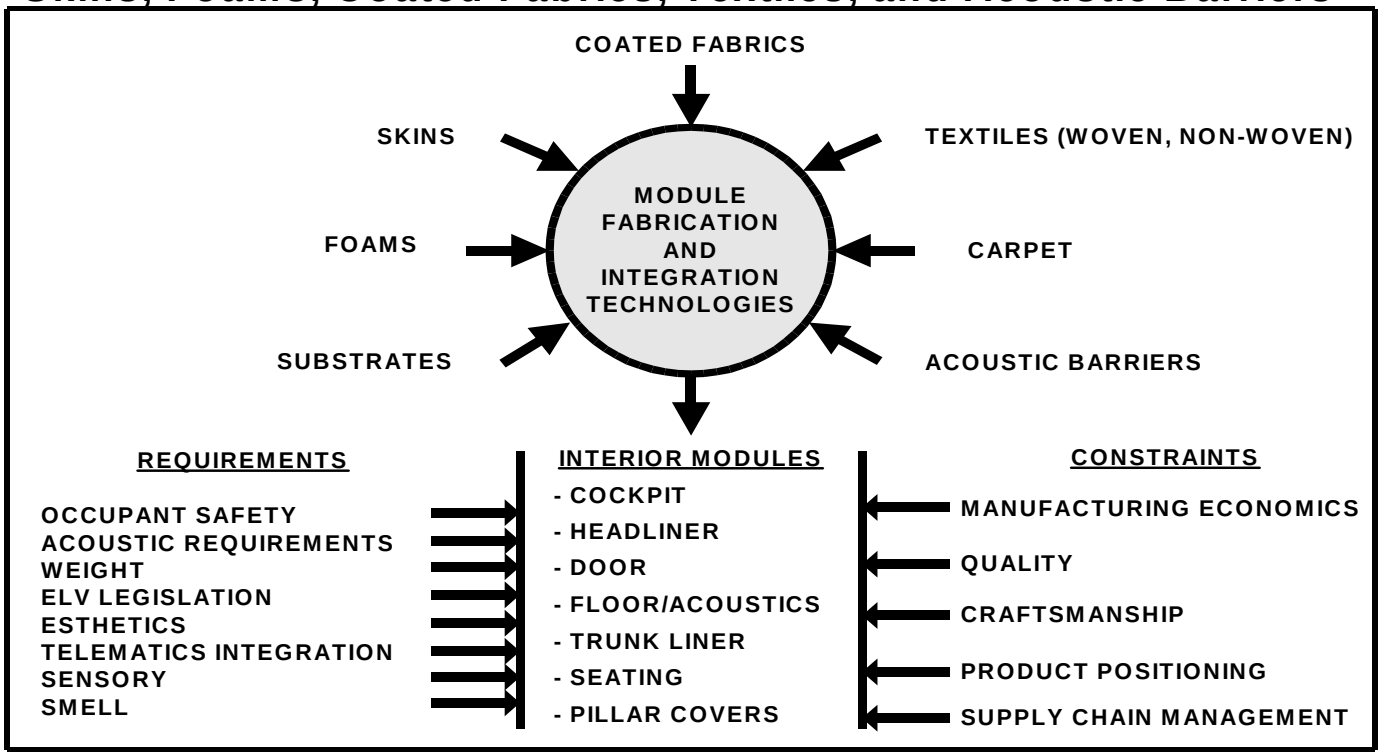
HIGHLIGHTS

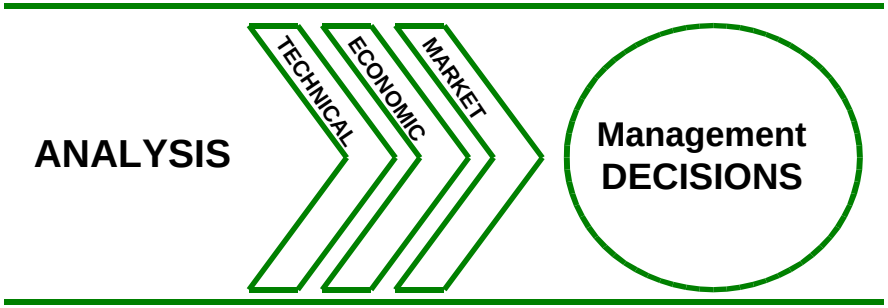
- **EFFECT OF ECONOMIC PRESSURES ON o-TPE MARKETS AND TECHNOLOGY**
- **VALUE-ADDED OPPORTUNITIES**
- **PATH TO MARKET SHIFTS/ROLE OF o-TPEs**
- **INTERMATERIALS COMPETITION**
- **ROLE OF:**
  - **NANO-FILLERS**
  - **SUPER-TPVs**
  - **HIGH PROPYLENE PLASTOMERS (hi-P-m-TPO)**
- **FOAM/FIBER GROWTH OPPORTUNITIES**



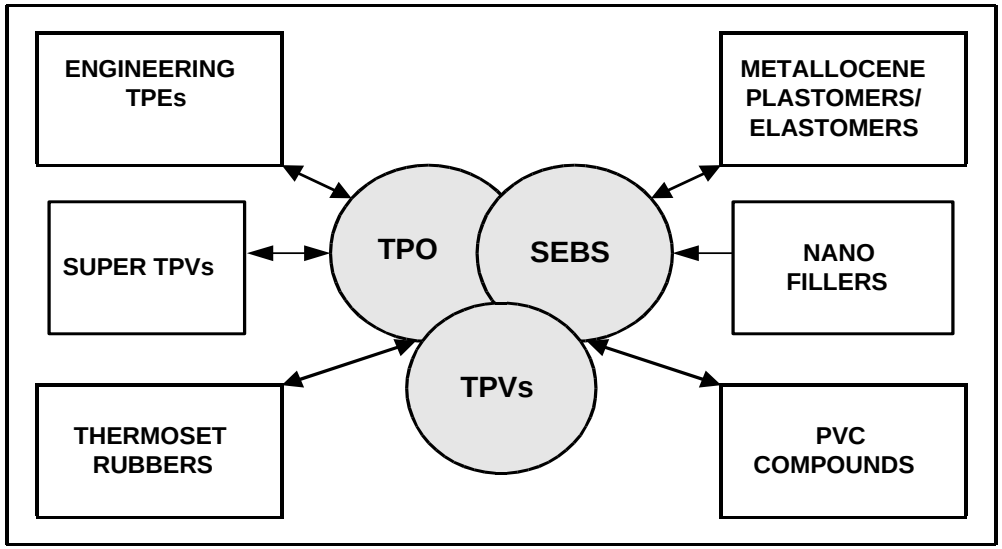
Automotive Interior Soft Trim:

Skins, Foams, Coated Fabrics, Textiles, and Acoustic Barriers





Specialty Thermoplastic Elastomers ..... Markets, Economics, Technology, Intermaterials Competition



Prospectus for a Euro/US/Japan Multiclient Industry Analysis

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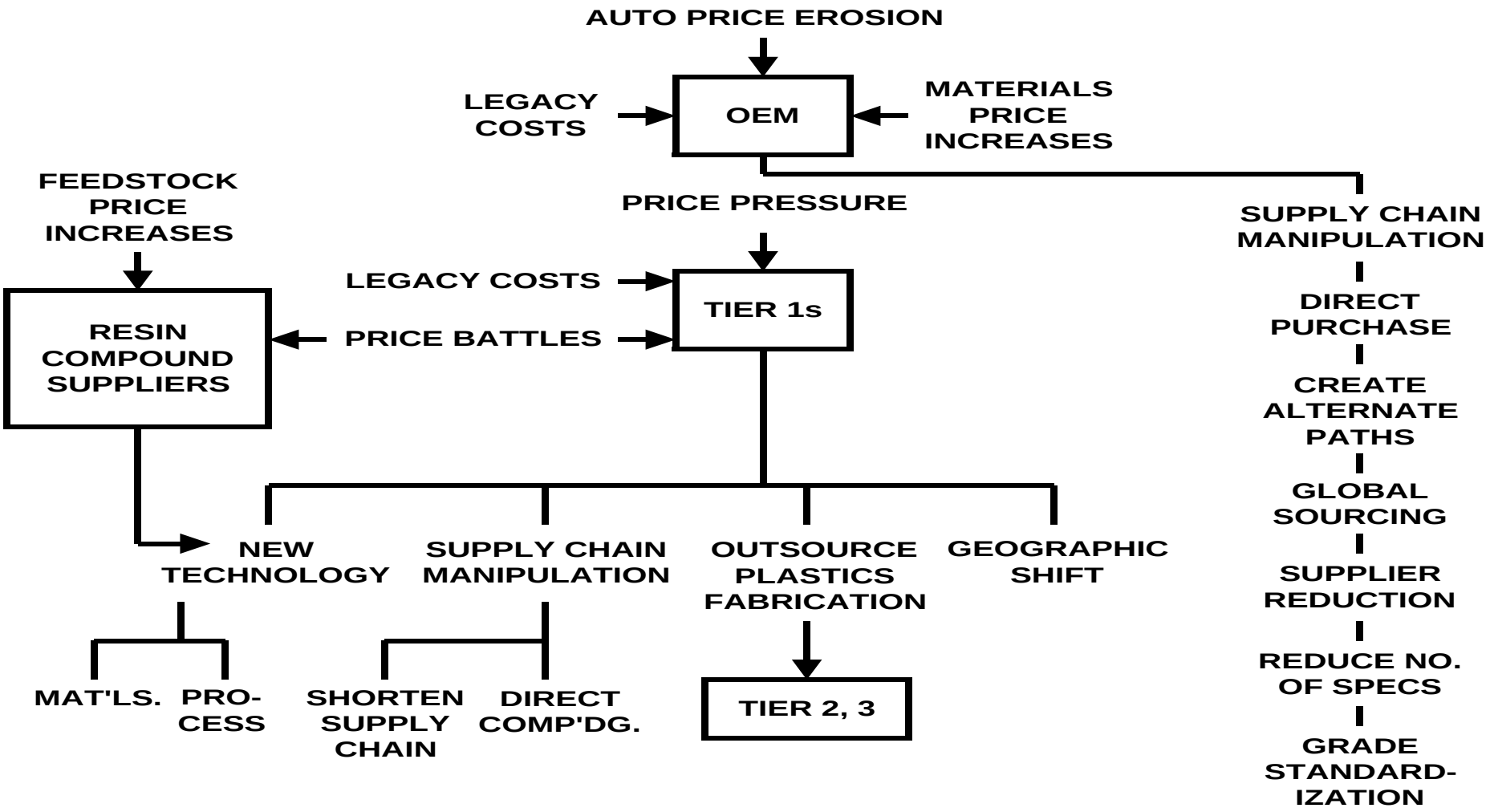
CURRENT AUTO/SUPPLIER DYNAMICS



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re/mydox/dow/auto suppl dyn 04.vsd
lg/myfiles/visio/auto suppl dyn 04.vsd

OLEFINIC TPEs (o-TPEs)

- **TPOs**
- **PARTIALLY CROSSLINKED TPVs**
- **FULLY CROSSLINKED TPVs**
- **PLASTOMERS**
- **HIGH ETHYLENE PP COPOLYMERS**
- **EMERGENCE OF STYRENIC TPVs (SEMI-OLEFINIC)**

NEW TPE COMPETITORS, TECHNOLOGIES, AND TARGETS

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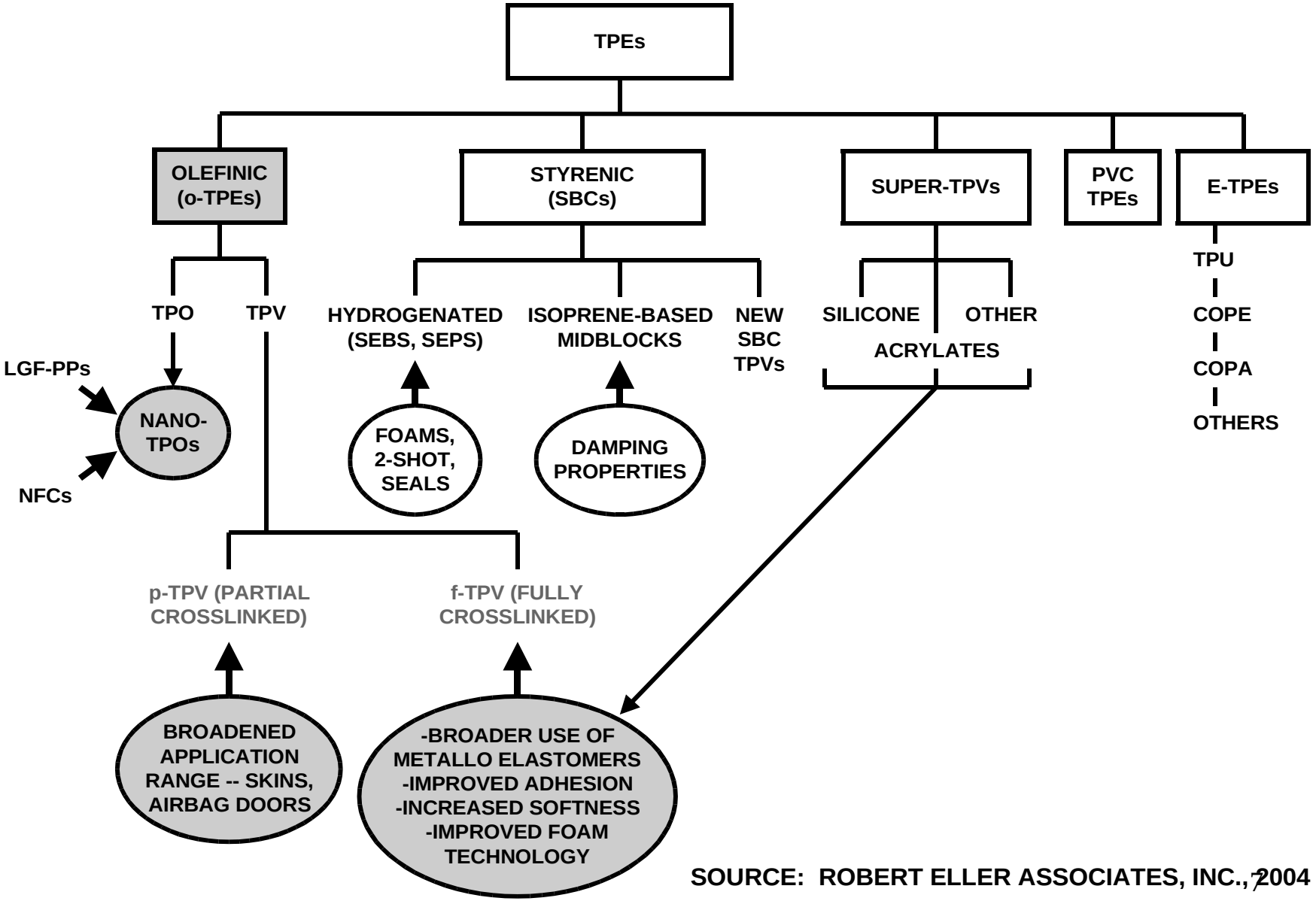


SOURCE: ROBERT ELLER ASSOCIATES, INC., 2004

OPERATING HYPOTHESES

- **TECHNOLOGY DRIVERS:**
  - **SUPPLY CHAIN SHIFT**
  - **BROADENED INTERMATERIALS COMPETITION**
  - **EUROPE, N. AMERICA AND JAPAN CONVERGENCE**
  - **CURRENT INTERIOR FABRICATION INEFFICIENT**
  - **IP: SOURCE OF MAT'L/PROCESS DEVELOPMENT EFFORTS**

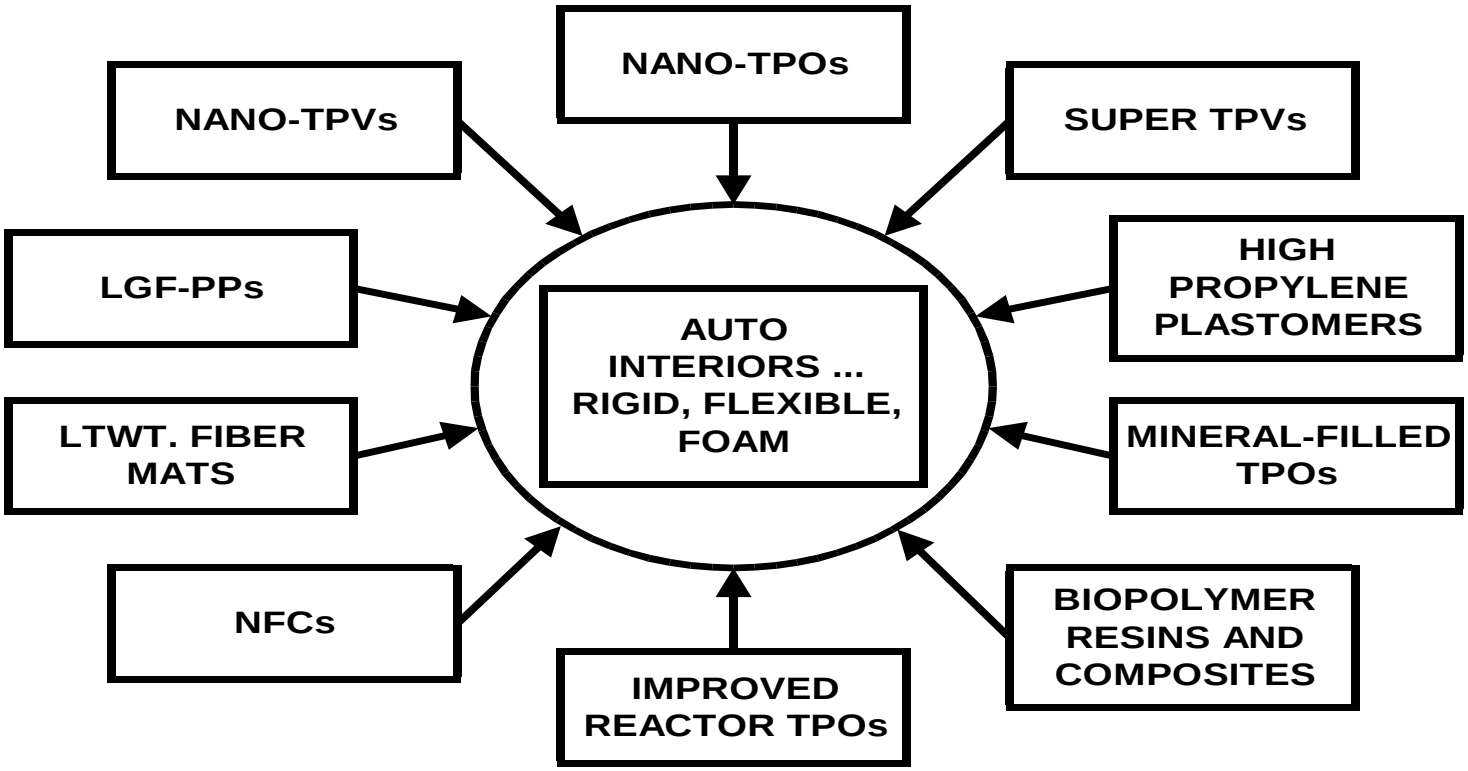
OPERATING HYPOTHESES (CONT'D)

- **ECONOMIC DRIVERS:**
  - **PRICE PRESSURE: SHIFTS IN o-TPE VALUE CHAIN**
  - **COMMODITY PRICE LEVELS**
  - **o-TPE VALE OPP'YS UNDER-EXPLOITED**
  - **ASIAN DEMAND GROWTH**
    - **KEEP MONOMER PRICE HIGH**
    - **PLACE PRESSURE ON FABRICATED PART PRICES**
    - **PROFITABILITY SQUEEZE ALL ALONG VALUE CHAIN**
    - **GEOGRAPHIC INVESTMENT FOCUS SHIFT**
    - **ASIAN COMPONENT IMPORTS STARTING**

OPERATING HYPOTHESES (CONT'D)

- **GROWTH DRIVERS:**
  - **HEAD IMPACT REGULATIONS (FMVSS 201/208)**
  - **ACOUSTIC PERFORMANCE**
  - **OLEFINIC FOAM DEMAND/PRICE SHIFT?**
  - **MATERIAL/PROCESS COST SAVINGS**

BROADENED INTERMATERIALS COMPETITION FOR AUTOMOTIVE INTERIORS APPLICATIONS



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VALUE CREATION FOR O-TPEs IN AUTOMOTIVE INTERIORS

VALUE CREATOR	EXAMPLE(S)
SUPPLY CHAIN CONSOLIDATION	-DIRECT COMPOUNDING/FABRICATION -CO-PROCESSING -USE OF CONCENTRATES -RIGID/FLEXIBLE COMBINATIONS
ELIMINATING LAYERS	-SKIN/FOAM COEXTRUSION -TWO-SHOT MOLDING OF LARGE PARTS
ELIMINATING COATINGS	-MOLDED-IN COLOR -BARRIER/ADHESIVE COATINGS
IN-PROCESS CRAFTSMANSHIP	-DOOR MEDALLIONS -DOOR TRIM -IP TRIM -NANO TPEs WITH LOW CLTE
SOFT TOUCH	-TWO-SHOT MOLDING (LARGE PARTS) -CO-EXTRUSION OF SOFT TOUCH SURFACED TPEs -INCREASES WITH INCREASED HARD SURFACE USE (IP AND DOOR TRIM)
IMPROVED SCRATCH/MAR RESISTANCE	-NANO-TPOs
USE OF RECYCLATE	-FLOOR MODULES -DOOR TRIM PANELS

VALUE CREATION FOR O-TPEs IN AUTOMOTIVE INTERIORS (CONT'D)

VALUE CREATOR	EXAMPLE(S)
IMPROVED RHEOLOGY	-LONGER FLOW -MULTI-SHOT MOLDING -THIN WALLING -PARTS CONSOLIDATION
SAVING WEIGHT	-VALUE INCREASE WITH CONTINUED HIGH FUEL PRICES
FOAMING	-BODY SEALS -SKINS -DOOR TRIM PANELS
MONOMATERIALS SANDWICHES	-SCRAP REDUCTION -REDUCED PROCESS STEPS
ACOUSTIC PERFORMANCE	-CONTROLLED DENSITY FOAMS -ELIMINATION OF HEAVY LAYER CONSTRUCTIONS IN FLOOR/ACOUSTICS MODULE
ON-BOARD ACOUSTICS/ENERGY ABSORBERS	-HEADLINERS -DOOR TRIM -PILLAR TRIM -FLOOR MODULE
IMPROVED STIFFNESS/IMPACT BALANCE	-DOOR TRIM -SUBSTRATES -THIN WALLING

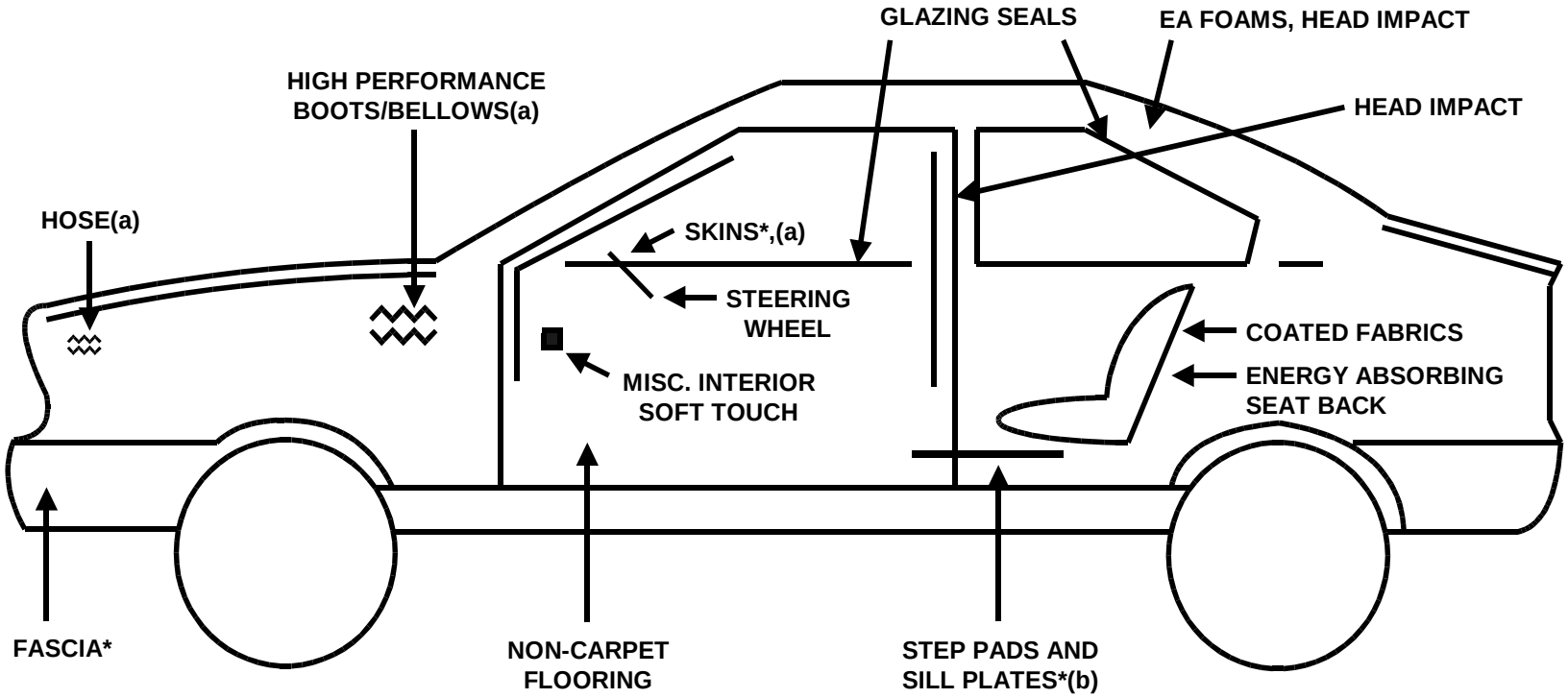
AUTO PP/TPO MARKETPLACE REALTIES

- **PRICE DRIFT/INSTABILITY**
- **EUROPEAN, JAPANESE & KOREAN OEMs SHARE OF N. AMERICAN MARKET GAIN**
- **RESIN SUPPLIER PROFITABILITY DECLINE**
- **HIGH LABOR COSTS, COMPETITION, & WEAK ECONOMY: VEHICLE PRICING PRESSURE**
- **PRIVATE EQUITY GROUP ENTRIES**
- **BUNDLING OF RESIN/COMPOUND SALES**
- **MAJOR RESIN SUPPLIERS EXITING**
- **OFFSHORE RESIN SUPPLIERS – ENTERING AUTO PO SECTOR**
- **COMPOUNDING EXCELLENCE – COMMANDS VALUE**
- **SUPPLY CHAIN CONSOLIDATION**
- **ASIA GROWTH IMPLICATIONS**

BROADENED PERFORMANCE ENVELOPE

- **SCRATCH/MAR RESISTANCE**
- **QUALITY OF MOLDED IN-COLOR APPLICATIONS**
- **FOAM PROPERTIES**
- **LOW TEMPERATURE PERFORMANCE**
- **ENERGY ABSORPTION CAPABILITY**
- **PERFORMANCE IN VALUE ADDED FABRICATION PROCESSES**
  - **CO-EXTRUSION**
  - **MULTI-SHOT MOLDING**
  - **SEQUENTIAL MOLDING**

EXAMPLE INTERIOR APPLICATIONS FOR RECENTLY DEVELOPED o-TPEs AND NANO-TPEs



NOTES:
*** INDICATES NANO-TPO OPPORTUNITY**
(a) SUPER-TPV TARGET
(b) LGF-PP AND NANO-TPO COMPETITIVE TARGET

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2004

b/mydox/papers/SPE TPO 04/SPE TPO 04-int oTPE nTPE 04.vsd
lg/myfiles/visio/SPE TPO 04-int oTPE nTPE 04.vsd

NANO o-TPEs

- **NANO-SIZED MINERAL FILLERS : LOWER CONCENTRATIONS (3-5 VS 12-20%), THEREBY:**
  - **AVOID COMPOSITE MORPHOLOGY DAMAGE**
  - **LOWER DENSITY**
  - **IMPROVED SCRATCH/MAR RESISTANCE**
  - **LOWER CLTE, BETTER DIMENSIONAL TOLERANCE**
- **CLAY NANO-TPOs: PENETRATION STARTED N. AMERICA (GM)**
- **ALTERNATIVE APPROACHES (EUROPE/JAPAN?)**
  - **FINER TALC**
  - **FORMULATION**
  - **COMPD'G PROCESS**

NANO FILLERS IN TPVs

- **CLAY FILLERS CURRENTLY USED IN TPVs**
- **SUBSTITUTION OF NANO-CLAYS IN EPDM PORTION ON o-TPV:**
  - **IMPROVE RHEOLOGY**
  - **BETTER PROCESSABILITY**
  - **REDUCE TAN δ VALUES**
  - **INCREASE STORAGE MODULUS**

SUPER TPVs (s-TPVs)

- **NEW GENERATION BASED ON A BROADENED RANGE OF ELASTOMERIC COMPONENTS**
  - **MARKET ENTRY PHASE**
  - **ENHANCED TEMPERATURE**
  - **OIL RESISTANCE**
  - **COULD PENETRATE AUTOMOTIVE INTERIORS**
  - **“SILKY” FEEL (SILICONE-TPV)**

SUPER TPV AND SBC TPV COMPETITORS

GRADE NAME	ELASTOMER TYPE	MATRIX RESIN(S)	SUPPLIER
TPSiV	SILICONE	PA, TPU	DOW CORNING
ZEOTHERM	POLYACRYLATE (ACM)	PP, PA, POLYESTER	ZEON
E-TPV	ETHYLENE ACRYLATE (AEM)	COPE	DUPONT
UNIPRENE XL	HYDROGENATED SBC (H-SBC)	PP	TEKNOR APEX
SEREL(a)	STYRENE BUTADIENE (SSBR)	PP	GOODYEAR
SEPTON V	H-SBC, REACTIVE HARD BLOCKS	SBC TRIBLOCK	KURARAY

NOTE:

(a) AVAILABLE IN MASTERBATCH FORM

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2004

INTERIOR APPLICATIONS FOR RECENTLY DEVELOPED TPEs AND KEY COMPETITOR TYPES

INT APPLICATIONS	O-TPE, COMPETITOR TYPE					
	NANO -TPO	s-TPV	PVC ALLOYS	HI-P-M-TPOs	LGF-PPs	SBC-TPVs
AIRBAG DOORS		X	X			X?
COATED FABRICS				X		X
DOOR TRIM/QUARTER PANELS	X					
ELASTIC FIBERS/TEXTILES				X		
IN MOLD DECORATION FILMS	X?					
IP SUBSTRATES	X					
SKINS	X		X		X	
SEAT BACKS	X				X(b)	
SOFT TOUCH		X				
STEP PADS	X				X	
PILLAR TRIM	X?			X?		
FLOOR MODULE					X	

NOTES:

(a) AN ANNOUNCED TARGET FOR DuPONT E-TPV

(b) WHERE IMPACT STRENGTH IS REQUIRED

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2004

SILICONE-BASED s-TPVs

- **TPSiV (DOW CORNING) – CROSSLINKED SILICONE BASED ELASTOMER ISLAND IN PA OR TPU MATRIX**
  - **GLAZING SEALS**
  - **AIRBAG DOORS**
  - **SOFT TOUCH COMPONENTS**
  - **CHEMICAL RESISTANCE**
  - **SKINS?**
  - **COATED FABRICS?**

ACRYLIC ELASTOMER-BASED s-TPVs

- **DUPONT – MODIFIED ETHYLENE-ACRYLATE RUBBER (AEM) IN A COPOLYESTER (COPE) MATRIX**
  - **HEAT RESISTANCE (3000 HRS) IN HOT ENVIRONMENT (150°C)**
  - **HOSE TARGET?**
- **ZEON'S s-TPV CANDIDATE – POLYACRYLATE RUBBER (ACM) IN PA (NYLON 6) OR COPE MATRIX**

STYRENIC ELASTOMERS

- **HYDROGENATED SBR, (SSBR), HYDROGENATED SBC (H-SBC):**
  - **GOODYEAR SEREL s-TPV**
  - **TEKNOR APEX – H-SBC**
  - **BOTH USE – PP MATRIX**
    - **IMPROVED OIL RESISTANCE**
    - **WET COEFFICIENT OF FRICTION**
    - **LONG TERM COMPRESSION SET**
  - **KURARY SEPTON V - H-SBC**
- **MASTERBATCH FORM**

SUMMARY

- **PRICE WARS**
- **SUPPLY CHAIN SHIFTS**
- **BROADENED PROPERTY ENVELOPE/COMPETITION**
- **ROLE FOR NANO-FILLERS**
- **ASIA IMPACTS**
- **FOAMS/COATED FABRICS: NEW OPPY'S**
- **BIOPOLYMERS GROWTH**
- **VALUE ADDED OPPORTUNITIES**